survival, local control or toxicity profile. Epidemiological data was searched to determine the proportion of new cases of cancer with each indication. Patient preference data were included for breast and prostate cancers. Indications and epidemiological data were reviewed by a court of external reviewers. Univariate and Monte Carlo simulations were used in sensitivity analysis.
Results: Over 600 papers and guidelines were reviewed for 20 cancer sites. The proportions of cancer types had changed markedly over 10 years. Prostate cancer increased from 12% of all cancers to 18%. The guidelines suggest that 48.6% of new cases of cancer have an indication for radiotherapy (with or without chemotherapy) at least once in the course of their illness. The range was from 0% for liver cancer to 94% for vaginal cancer. 9.1% of cases had an indication for synchronous chemoradiotherapy.
Conclusions: The small decrease in optimum radiotherapy utilisation rate was mostly due to changes in the proportions of cancer in the population and the removal of a small numberof indications for radiotherapy.

PD-0368
Activity and infrastructure of radiotherapy in the European countries: Initial data from the ESTRO HERO survey
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Purpose/Objective: Documenting key parameters for the activity, utilization and infrastructure of radiotherapy in Europe is an important part of HERO - the ESTRO Health Economics in Radiation Oncology project [1]. HERO has the overall aim to develop a knowledge base of the provision of radiotherapy in Europe and build a model for health economic evaluation of radiation treatments at the European level. The aim of the current report is to describe the initial analysis of a pan-European survey of radiotherapy activity and infrastructure.
Materials and Methods: Contact persons representing the national societies within radiation oncology in 42 European countries were identified from the ESTRO database and personal contacts. The contact persons were asked to respond to an 84-item web-based questionnaire detailing epidemiology (population, cancer types and cases per year), radiotherapy activity (number of courses, number of patients treated), infrastructure (departments and technology), staffing and economics (public/private facilities, type of reimbursement), all on a national level. By December 2012, a total of 29 European countries have entered their data.
Results: A large variation between countries was found for most parameters studied. Between countries the proportion of annual patients treated with radiotherapy relative to all new cancer cases varied from 20% to 55% (median 39%); the number of MV machines per million inhabitants from 1.25 to 9.62 (median 5.29) and the average number of MV machines per department from 0.8 to 8.0 (median 2.0). The average number of patients treated per year per MV machine varied from 205 to 862 (median 325), per radiation oncologist (89 to 266; median 167), per radiation physicist (121 to 435; median 263), and per radiation therapist (23 to 595; median 101).
Conclusions: The initial results of this survey have documented an enormous heterogeneity, in the order of a factor of 3-5, in all key parameters related to activity, utilization, infrastructure and staffing of radiotherapy in Europe. Radiotherapy seemed to be underutilized in most countries when compared to evidence based data from CCORE [2], although there has been a positive evolution in availability and infrastructure compared to the earlier studies [3,4]; the European average number of MV machines per million inhabitants and per department is now in line with QUARTS recommendations [4]. The data will be further analyzed in the context of the ESTRO HERO project, in collaboration with the national societies and the International Atomic Energy Agency.
1. Lievens Y, Grau C. Radiother Oncol 2012: 103:109-112
2. Delaney GP, Jacob S et al. Cancer 2005: 104: 1129–1137
3. Bentzen S, Heeren G et al. Radiother Oncol 2005:75:355-65
4. Slotman B, Cottier B, et al. Radiother Oncol 2005:75:349-54

PD-0369
Assessing the percentage of patients who need radiotherapy in Europe: An exploratory analysis from the HERO project
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Purpose/Objective: ESTRO has launched the Health Economics in Radiation Oncology (HERO) project to develop a knowledge base and a model for health economic evaluation of radiotherapy (1). In this framework, the need for radiotherapy will be assessed in order to explore the optimum radiotherapy utilization in Europe. The percentage of new cancer patients who require radiotherapy relative to the total number of cancer patients (Attributable Radiotherapy Percentage, ARP) is one of the usual measures for planning purposes of radiotherapy equipment and staffing. The objective of this work was to assess the variability of ARP according to the differences in proportional incidence and in stage at diagnosis by country in Europe.
Materials and Methods: Decision trees from the Australian CCORE-projectwere used to assess the percentage of patients requiring evidence-basedradiotherapy (2). The original incidence data were substituted with theproportional distribution of cancers in different European countries, based onincidence data for 2008 from Globocan (www.iarc.fr). Available data on population-based stage at diagnosis were used for head and neck, lung, breast, prostate and rectal cancer in selected countries, used for exploratory purposes. The analysis was carried out with TreeAge software.
Results: The range of values of ARP among European countries varied from 52% to 57% of new cancer cases. Stage at diagnosis also contributed to the variability of ARP estimates with a range from 2% in breast cancer to 15% in rectal cancer. Most relevant factors influencing the ranges of values observed were due to the percentage of cases diagnosed at earlystage with surgery as the only treatment in rectal cancer; and the important variability in the incidence by country of head and neck cancer and prostate.These estimates were evidence based and did not take into account clinical problems such as comorbidity that could influence the decision for treatment. Also, the number of patients that could require retreatment is not included in the estimate. Both factors could modify significantly the final ARP percentage of incidence cases for planning radiotherapy in a specific country.
Conclusions: ARP is a useful indicator for assessing the needs for radiotherapy; however, national differences in the incidence of cancer and stage at diagnosis should be taken into account in order to make a more realistic estimate for planning purposes. The range observed betweencountries and tumour stages could translate into a significant change in the number of facilities required.
1. Lievens Y, Grau C. Health Economics in Radiation Oncology: Introducing the ESTRO HERO project. Radiother Oncol 2012; 103:109-112
2. Delaney GP, Jacob S, Featherstone C, Barton MB. The role of radiotherapy in cancer care: estimating optimal utilization from a review of evidence-based clinical guidelines. Cancer 2005; 104: 1129-1137

PD-0370
Radiotherapy utilisation in NSW and ACT [2004-06], a data linkage and GIS experience
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Purpose/Objective: Delaney et al (2003) estimated that more than half of all cancer patients should receive radiotherapy at some point during the course of the disease. Actual Radiotherapy Utilization (RTU) rates are usually lower than the optimal rates
Our objectives were:

1) To calculate the actual RTU rates in NSW & ACT (2004-06) directly from patient treatment records with special emphasis on the effect of geographic variation on RTU.
2) To identify factors affecting RTU
Materials and Methods: Radiotherapy treatment data were collected from all 17 radiotherapy departments (RTD) in NSW and ACT for the period January 2004-June 2007. Through Center for Health Record Linkage, the radiotherapy data and Central Cancer Registries (CCR) records in NSW & ACT were linked. . All patients' residential addresses were geocoded. A Geographic Information System (GIS) software was used to calculate the road distance between patients' residential address and the closest RTD. Patients were excluded from the study if their nearest RTD was outside NSW or ACT.
Results: The overall raw RTU rate in NSW and ACT (2004-06) was 32%. After data linkage with CCR records, the overall RTU rate was 24% for unique patients diagnosed and received radiotherapy within the study period. Excluding patients at the borders with other States, the RTU rate was 26%. The RTU rates decreased with increasing distance from patient residence to the nearest radiotherapy facility (p <0.0001). RTU ranged from 27% for those who lived less than 50 km to 19% for those who lived 400+ Km from the nearest RTD. Older patients were less likely to receive RT than younger ones (p<0.001) and female younger patients were more likely to receive RT than younger males (p<0.001). Our study did not show a correlation between receiving RT and the socioeconomic status of patients using Index of Relative Socioeconomic Disadvantage quintiles.
Conclusions: This is the first study to use data linkage to match radiotherapy treatment data received from all RTD to all CCR records in NSW and ACT. It is also the first study to calculate the road distance between patient residence and the nearest radiotherapy facility. There was a statistically significant difference in radiotherapy access based on road distance.

PD-0371

Comparative cost / QALY of guideline-recommended prostate cancertreatments: a UK cost perspective

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Purpose/Objective: To estimate the expected comparative costs/Quality Adjusted Life Year (QALY) gained of the guideline recommended treatments Active Surveillance (AS), Radical Prostatectomy (RP), Brachytherapy (BT), EBRT and appropriate combinations hereof incl. Androgen Deprivation Therapy (ADT) in patients with low, intermediate or high risk prostate cancer over a time horizon of 10 years from an UK-NHS cost perspective.
Materials and Methods: A decision analytic model was developed considering survival, health related quality of life and costs associated with 1) initial treatment and 2) management of relapse, local recurrence, metastasis, and 3) treatment-associated complications and morbidities. The wide range of appropriate treatments to be compared for low, intermediate and high risk prostate cancers were based on NICE, EAU, AUA and NCCN guidelines. Survival, relapse, recurrence, metastasis and complication rates, as well as health-related quality of life and cost data were based on systematic reviews of the published literature and expert opinions where required. Probabilistic sensitivity analysis, using 10000 Monte Carlo simulations, quantified the joint decision uncertainty surrounding model outcomes at the prevailing threshold of £20k-30k/QALY.
Results: In low risk prostate cancer, AS has the highest probability for being cost-effective (C/E), i.e. 70%. When AS is unacceptable to a patient, BT dominates EBRT by generating more QALYs/patient (+0,06) at lower cost (-£14k) over 10-years. EBRT is C/Evs. RP as shown by the incremental C/E ratio of £7k/QALY which is far below the WTP threshold. In intermediate risk, EBRT+BT is the dominating treatment (5,02QALYs at £14.7k; 65% probability C/E), followed by BT as monotherapy (4,98QALYs at £16.9k; 35% probability C/E). RP generates the lowest QALYs at relatively high costs (4,06 QALYs, £28.8k). In high risk, all mono and combination radiation treatments dominate RP which generates 3,96 QALYs at £35.4 over 10 years/patient. EBRT+BT (4,7 QALYs, £35.1k) is most C/E compared to monoradiation treatments by generating more QALYs at only slightly higher total costs. BT (4,65 QALYs, £32.5k) dominates EBRT (4,62 QALYs, £32.5k) and EBRT+ADT(4,47 QALYs, £37.7k).
Conclusions: Across risk groups, RP is likely to perform worse than radiation treatments in terms of expected costs/QALY. In intermediate and high risk prostate cancer, EBRT+BT is expected to provide highest QALYs at acceptable or lower cost than monoradiation treatments and RP. In low risk prostate cancer, AS is preferred in terms of QALYs, while BT dominates EBRT and RP in terms of costs/QALYs.

PD-0372

The cost of hadron therapy in Belgium: Comparison of a business model with activity-based costing.

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Purpose/Objective: In the framework of a feasibility study for a hadron therapy centre in Belgium, cost calculations are performed by means of two separate models, with the aim to determine the treatment cost per patient and to estimate the need for reimbursement for different technical solutions.
Materials and Methods: The Business Model (BM) analyses the financial implications of setting up a facility over time, taking into account all costs incurred from the preparatory phase, first investment and commissioning, over the ramp-up period where the centre starts to accrue patients, until operation at full capacity and beyond. The Activity-Based Costing (ABC) model calculates the costs for a centre in a specific year corresponding to a steady state of operation. Both models analyse private financing compared to financing with public investment to cover investment costs. Three different technical solutions are considered, all with two treatment rooms: a combined proton/carbon ion centre, a dedicated carbon ion and a dedicated proton centre. Input parameters for both models (investment and operational costs, patient population, fractionation schedules and time slots) are derived from discussions with international experts and literature.
Results: The total investment cost ranges from 51,5 M€ for a dedicated proton centre up to 101,5 M€ for a combined centre. The annual operational cost is influenced by the financing system and ranges from 10,0 M€ (proton centre, public financing) up to 24,8 M€ (combined centre, private financing).
Table 1 summarizes the required reimbursement per patient necessary to yield a positive cumulative net cash flow after 16 years of operation using the BM, and the average cost per patient and cost per type of treatment and fraction using the ABC model. Costs are expressed in Euro for the year 2012.

Table 1

	Combined centre	Two-room carbon ion centre	Two-room proton centre
Number of patients/year	534	760	355
Number of fractions/year	10485	11400	10650
Private financing			
Business model vs Activity-Based Costing			
BM: required reimbursement per patient	51.150	32.400	51.200
ABC: average cost per patient	46.443	29.450	46.342
Actvity-Based Costing: cost per type of treatment			
proton treatment (30 fractions), pediatric patient	69.701	-	61.591
proton treatment (30 fractions), adult patient	48.185	-	43.842
carbon ion treatment (15 fractions), adult patient	42.749	29.450	-
proton fraction, pediatric patient	2323	-	2053
proton fraction, adult patient	1606	-	1461
carbon ion fraction, adult patient	2850	1963	-
Public financing			
Business model vs Activity-Based Costing			
BM: required reimbursement per patient	27.550	18.400	32.300
ABC: average cost per patient	23.956	16.059	28.296
Actvity-Based Costing: cost per type of treatment			
proton treatment (30 fractions), pediatric patient	35.579	-	34.878
proton treatment (30 fractions), adult patient	26.791	-	27.217
carbon ion treatment (15 fractions), adult patient	21.507	16.059	-
proton fraction, pediatric patient	1186	-	1163
proton fraction, adult patient	892	-	907
carbon ion fraction, adult patient	1434	1071	-

As they disregard the impact of inflation, the costs calculated with ABC are lower than the required reimbursement based on the BM.
Sensitivity analyses show that the required reimbursement for privately financed centres is highly sensitive to the delay in commissioning and to the interest rate. Uncertainties in investment cost have a greater impact on treatment cost and required reimbursement than changes in personnel costs. Operating scenario, product mix and fractionation schedules have a significant impact on the cost per treatment and per fraction.
Conclusions: To align costs to European reimbursement rates, our calculations suggest that the financially most attractive option for Belgium is a dedicated carbon ion centre with public financing. The choice however also depends on the clinical indications and the socio-political context.